ZOELLER®
ENGINEERED PRODUCTS

Continuous Duty Vs. Continuous Operation (a.k.a Continuous Run)

Zoeller periodically receives questions from customers and representatives regarding continuous and intermittent pump operations. While the questions posed are simple enough, the explanations can sometimes be more complicated. The crux of the issue involves several terms that sound similar but have different meanings. These terms are often tossed around incorrectly and this frequently leads to confusion in the industry. In this article, we will take a deeper dive into the differences between *Continuous Duty* and *Continuous Operation* (also called *Continuous Run)* in order to shed some light on this shadowy issue.

Continuous & Intermittent Duty

The *duty* rating of a pump is tied to the thermal characteristics and requirements of the motor. All motors generate heat when they operate. They also have critical thermal limits and if a working motor exceeds a certain temperature, bad things start to happen. The motor's stator includes lots of wire which is coated with a thin insulation to prevent electrical shorting. If this insulation gets too hot, it will become unstable and begin to break down. As the insulation degrades, electrical current can begin to arc from one wire to another which is a death knell for a motor. For these reasons, managing the thermal rise in a motor is important for any manufacturer.

There are many ways to keep a motor from advancing past its thermal limits. One way is to limit the amount of time it can run in an application. Some manufacturers state that their product can only run for a certain stretch of time, called an intermittent duty cycle, before it must rest. The rest period must be long enough for the motor to completely cool back to ambient temperature before beginning another cycle. These products are referred to as being *Intermittent Duty*. By comparison, if a product is designed in such a way that it can operate indefinitely without exceeding the motor's thermal limits, it is referred to as being *Continuous Duty*.

During pump design and testing, Zoeller pays close attention to the heat generated by the motor. Almost all of Zoeller's pumps are made with cast iron housings and filled with a dielectric oil, specifically to aid in heat dissipation. This tried-and-true practice is excellent for keeping the pump motors well below their thermal limits. As soon as a pump is called to run, its motor will begin generating heat. The heat of the motor transfers to the oil, which transfers to the cast iron, which transfers to the surrounding air and water. After enough time passes, the pump arrives at a thermal equilibrium whereby the pump housing is radiating heat to the environment at the same rate that it is being generated within the motor. In Zoeller pumps, this thermal stability occurs at temperatures safely below the limits of the motor. As such, Zoeller pumps are nearly all rated as *Continuous Duty*. If you put a Zoeller pump into an application with a proper minimum liquid level, operate it somewhere on the published curve, and ensure that the ambient temperature is within allowable ranges, then it can run indefinitely without overheating. As a required safety precaution, Zoeller utilizes thermal overloads and thermal sensors. Depending on the pump model, either overloads or sensors are imbedded in the motor stator windings. Overloads are self-contained and protect the motor without external circuitry, while thermal sensors require a special circuit in a control panel to function. Regardless, the pumps are designed to operate indefinitely in appropriate applications without tripping any of these thermal protections.

Continuous & Intermittent Operation (or Run)

In contrast to the technical nature of *Continuous Duty*, *Continuous Operation* is more straightforward. This is generally what people mean when they bring up the topic of continuous versus intermittent in the first place. *Continuous Operation* in a pump system simply means that the pump runs non-stop, and *Intermittent Operation* means that the pump will start and stop

periodically. *Intermittent Operation* is what Zoeller expects from most of the applications into which its pumps are placed. Consider a sump pump basin or a sewage lift station: Water enters the wet well and the water level increases until it reaches a tripping point. The trigger could be a float switch, a floatless switch, or transducer. Regardless, the resting pump is called to run a cycle during which the water level reduces to some lower tripping point and the pump stops.

Pumps are machines with components that wear over time. Parts like bearings and shaft seals don't last forever. Zoeller chooses components for its products that will provide a long and reliable service life for a reasonable price. In making these choices, Zoeller considers how its pumps will be used in most applications. For instance, the average residential sewage pump under normal circumstances runs no more than 20 minutes a day and can provide faithful service for many years. But if the same pump were put into an application and operated continuously, it would incur 10 years' worth of wear in just under 2 months! That certainly doesn't mean that the pump will fail in 2 months, but the pump's overall service life will be greatly reduced compared to a pump operating in a more typical, intermittent fashion. Zoeller pumps are designed to meet the demands of their intended applications, but that means that certain applications are not appropriate for our pumps. Zoeller sump and sewage pumps are generally not recommended for *Continuous Operation*. Running pumps non-stop subjects them to a much greater rate of wear than they were designed to tolerate. There are some pump models in the product line that are rated for *Continuous Operation*, but these have been built with certain critical upgrades that allow them to withstand the rigors of non-stop use.

A related topic affecting pump longevity involves the number of starts per hour. Starting a pump from rest subjects it to harsh forces and high current loads. Of course, pumps are designed to withstand these forces. But starting a pump too frequently causes excessive wear over time, increases operating temperatures, and may lead to premature failures. Larger motors should be started less frequently than smaller motors. Based on NEMA motor guidelines, Zoeller recommends designing systems to limit the number of starts per hour based on the following schedule. Exceeding these values periodically isn't problematic, but a good design will keep the number of starts below these thresholds most of the time.

MOTOR HORSEPOWER RANGE	MAX STARTS PER HOUR	MINIMUM CYCLE TIME
1.5 HP and Less	12 Starts / Hour	1 Cycle Every 5 Minutes
2 HP to 7.5 HP	7 Starts / Hour	1 Cycle Every 9 Minutes
10 HP and Greater	5 Starts / Hour	1 Cycle Every 12 Minutes

Lowering the number of starts typically involves expanding the on/off operating range by increasing the span between floats, but sometimes requires increasing the design size of the sump pit or basin.

Pumps are not unlike automobiles. If you buy a new car, take care of it, and drive it 20,000 miles each year, it is reasonable to expect that you'll still be driving it in 10 or maybe even 20 years. However, if you spend your life on the road and rack up 200,000 miles each year, you'll be lucky to get 2 years before the vehicle is spent. The shortened life in the second scenario isn't a reflection of design problems or poor quality, rather it is just the natural result of many service hours! By running a pump continuously that wasn't designed to do so, you can expect a similar shortening of its service life due simply to wear and tear.